DOCUMENT RESUME

ED 097 497 CE 002 265

TITLE	The Complete Black and White Television Receiver and Introduction to Color; Radio and Television Service--Advanced: 9787.03.
INSTITUTION	Dade County Public Schools, Miami, Fla.
PUB DATE	Dec 72
NOTE	21p.; An Authorized Course of Instruction for the Quinmester Program
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	Course Content; Course Objectives; *Curriculum Guides; *Electronic Equipment; Job Skills; Post Secondary Education; Secondary Grades; Skill Development; Technical Education; *Television; *Video Equipment; Vocational Education
IDENTIFIERS	Florida; *Quinmester Program

ABSTRACT

The course described in this pamphlet completes the theory of black and white television and introduces the student to basic color. Course content includes goals, specific block objectives, the cathode-ray tube (electrostatic and electromagnetic control), video IF amplifiers and detectors, sound IF amplifiers and audio detectors, colorimetry, requirements of the composite color signal, and color picture signal. A posttest sample and a bibliography are included. (NH)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-29

Course Outline

RADIO AND TELEVISION SERVICE - ADVANCED - 9787

(The Complete Black and White Television Receiver and Introduction to Color)

Department 48 - Quin 9787.03

DADE COUNTY PUBLIC SCHOOLS

DIVISION OF INSTRUCTION • 1973

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D A D E C O U N T Y P U B L I C S C H O O L S
1 4 5 0 N O R T H E A S T S E C O N D A V E N U E
M I A M I, F L O R I D A 33132

Course Outline

RADIO AND TELEVISION SERVICE - ADVANCED - 9787
(The Complete Black and White Television Receiver and Introduction to Color)

Department 48 - Quin 9787.03

county office of

VOCATIONAL AND ADULT EDUCATION

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

December, 1972

Published by the School Board of Dade County

Course Description

9787	48	9787.03	The Complete Black and White Television Receiver and Introduction to Color
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester course will complete the theory of black and white television and introduce the student to basic color. The course features a study of the sound signal path, alignment procedures, and the theory of color transmission and reception. Laboratory experiments and live production work on black and white television receivers supplement the text material.

Indicators of Success: Prior to entry into this course the student must be able to master the skills indicated in "Television Sweep Circuits and Picture Signal Path" (9787.02).

Clock Hours: 135

PREFACE

The following pages contain a course outline entitled "The Complete Black and White Television Receiver and Introduction to Color," quinmester course number 9787.03.

This quinmester course is the thirteenth of a series of fourteen courses in radio and television service. The course is covered in eight blocks and is 135 clock hours in length. It is concluded by a post-test.

Upon completion of this course the student will be well-versed in the theory of operation of black and white television, service procedures, and the basic theory of color as it applies to color TV reception and transmission.

The teaching methods will vary according to the ability of the individual student. As the content of the course varies, teaching techniques which lend themselves to each particular situation are employed. The instructor uses demonstrations and lectures which are supplemented by the performance of laboratory experiments, live production work, and assignments by the student. The instruction is further developed by the use of films, information sheets, diagrams, and other aids which make the instruction more meaningful.

This outline was developed through the cooperative efforts of instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service, Division of Vocational and Adult Education, and has been approved by the Dade County Vocational Curriculum Committee.

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with Suggested Hourly Breakdown

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GOALS

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The student will be able to:

1. Demonstrate an understanding of the physical and electronic requirements of a cathode-ray tube. (CRT)

2. Understand the operation of video IF amplifiers and video detectors and explain the various types of coupling.

3. Explain the methods used for IF alignment and the need for alignment.

4. Show understanding of sound take-off, amplification, and FM detection.

5. Show understanding of the way colors effect the human eye and how this effect is used in color TV.

6. Show understanding of the requirements for transmitting a compatible color signal and the methods used to meet these requirements.

7. Explain the voltage and phase relationships used to obtain luminance and chrominance signals for compatible color TV.

8. Satisfactorily complete the post-test.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - THE CATHODE-RAY TUBE - ELECTROSTATIC CONTROL

The student must be able to:

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1. List the five requirements for an electrostatically controlled cathode-ray tube.
2. Name the four major elements of an electron gun in a cathode ray tube.

BLOCK II - CATHODE-RAY TUBE - ELECTROMAGNETIC CONTROL

The student must be able to:

1. Name three methods which have been used to obtain focus in television.
2. Describe the shape of the waveform which must be applied to the deflection coils in order to obtain linear horizontal and vertical deflection.
3. List two types of particles emitted by the cathode of an electron gun in a CRT.
4. Describe, to the satisfaction of the instructor, the physical makeup of an aluminized CRT.

BLOCK III - VIDEO IF AMPLIFIERS AND DETECTORS

The student must be able to:

1. Draw the block diagram of a complete black and white television using intercarrier sound.
2. Define intercarrier sound in 25 words or less.
3. Name two methods used to obtain the wideband IF response required for a television receiver.
4. List three of the four types of circuits which may be used to accomplish adjacent-channel rejection.

BLOCK IV - SOUND IF AMPLIFIERS AND AUDIO DETECTORS

The student must be able to:

1. State orally, the method used for sound take-off in a modern television receiver, giving the frequency of the sound signal and the type of modulation employed in T.V. sound systems.
2. List three of the five types of audio detectors used in television receivers.

BLOCK V - COLORIMETRY

The student must be able to:

1. List, in writing, the primary and complementary colors used in color television.

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2. State what percentage each of the primary colors must contribute in order to obtain white light.
3. Define the term "hue" in ten words or less.
4. Define the term "saturation" as used in color TV in ten words or less.
5. Define the term "brightness" as used in color TV in ten words or less.

BLOCK VI - REQUIREMENTS OF THE COMPOSITE COLOR SIGNAL

The student must be able to:

1. Define the term "chrominance signal" in fifteen words or less.
2. Demonstrate an understanding of color burst by listing its purpose, method of transmission, and required number of cycles.

BLOCK VII - THE COLOR PICTURE SIGNAL

The student must be able to:

1. List the five signals which make up the composite color signal.
2. Define the term "color difference signal" to the satisfaction of the instructor.
3. State the phase relationship between the I and Q signals and the phase relationship of each to the burst signal.

BLOCK VIII - QUINMASTER POST-TEST

The student must be able to:

1. Satisfactorily complete the Quin Post-Test.

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Course Outline

RADIO AND TELEVISION SERVICE - ADVANCED - 9787

(The Complete Black and White Television Receiver and Introduction to Color)

Department 48 - Unit 9787.03

I. CATHODE-RAY TUBE - ELECTROSTATIC CONTROL

A. Beam Formation
   1. Grids
   2. Anodes

B. Beam Control
   1. Grid Control
      a. Positive
      b. Negative
   2. Focus
      a. Positive potential
      b. Zero potential
   3. Deflection
   4. Centering

C. Beam Effect on a Fluorescent Screen
   1. Lighting
   2. Burns

II. CATHODE-RAY TUBE - ELECTROMAGNETIC CONTROL

A. Focusing

B. Deflection

C. Centering

D. Ion Removal
   1. Physical
   2. Magnetic

III. VIDEO IF AMPLIFIERS AND DETECTORS

A. Video IF Systems
   1. Response requirements
      a. Bandwidth
      b. Waveform
   2. Methods of obtaining response
      a. Overcoupling
      b. Staggered tuning

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3. Adjacent and co-channel rejection
   a. Traps
      (1) Series traps
      (2) Shunt traps
      (3) Degenerative traps
   b. Bridged-T networks

B. Video Detectors
   1. Tube type
   2. Semiconductors

IV. SOUND IF AMPLIFIERS AND AUDIO DETECTORS

A. Audio IF Takeoff

B. Typical Audio IF Systems

C. Audio Detectors
   1. Discriminators
   2. Ratio detectors
   3. The gated-beam detector
   4. The locked oscillator detector
   5. The delta detector

V. COLORIMETRY

A. Vision
   1. Brightness
   2. Contrast

B. Light Sources
   1. Direct
   2. Indirect

C. How Color Appears to the Eye
   1. Hue
   2. Saturation
   3. Brightness

D. Color Mixtures
   1. Primary colors
   2. Complementary colors

E. Color Specifications
   1. Standards
   2. Tristimulus values
   3. Mathematic derivations

VI. REQUIREMENTS OF THE COMPOSITE COLOR SIGNAL

A. Interleaving
   1. Energy concentration
   2. Frequency determination

VI. REQUIREMENTS OF THE COMPOSITE COLOR SIGNAL (Contd.)

B. Subcarrier Frequencies

C. Divided Carrier Modulation
   1. Phase
   2. Frequency
   3. Doubly balanced modulation

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D. Color Sync
   1. Color burst
   2. Method of transmission

VII. THE COLOR PICTURE SIGNAL

A. Luminance
   1. Comparison to video signals
   2. Proportion of each primary color

B. Chrominance
   1. R-Y
   2. B-Y
   3. G-Y
   4. The I and Q signal

C. Bandwidths
   1. I signal
   2. Q signal
   3. Color subcarrier

D. The Color Bar Pattern
   1. E_R, E_B, E_G, and E_Y signals
   2. Relative saturation

E. Vector Relationships
   1. Burst
   2. Red
   3. Blue
   4. Green

VIII. QUIMESTER POST-TEST

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BIBLIOGRAPHY

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Basic References:

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2. _____. Photofact Television Course. 3rd ed. Indianapolis: Howard W. Sams & Company, 1971. Pp. 192

Supplementary References:

3. Brite, Robert J., et al. Transistor Fundamentals. Book 2. 1st ed. Indianapolis: Howard W. Sams & Company, 1968. Pp. 208.

4. Deane, Leslie D. & Young, Calvin C. TV Servicing Guide. 1st ed. Indianapolis: Howard W. Sams & Company, 1968. Pp. 132.

5. Grob, Bernard. Basic Television. 3rd ed. New York: McGraw-Hill Book Company, 1964.

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9. _____. Synfact Guide to TV Servicing. Indianapolis: Howard W. Sams & Company, 1970. Pp. 160.

10. _____. Television Service Manual. 3rd ed. Indianapolis: Howard W. Sams & Company, 1970. Pp. 544.

Films:

1. Breath of Life. 16 mm. 16 min. Color. Sound. 1968. EJST. #1-13376.

2. Cathode Ray Tube: How It Works. 16 mm. 15 min. BW. UW. #1-12974.

3. Localizing Troubles (Television). 16 mm. 11 min. BW. Sound. McGraw-Hill. #1-05519.

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Films:

4. Practical TV Alignment. 16 mm. 16 min. BW. Sound. #1-13908.

5. Television Picture Tube Implosions. 16 mm. 6½ min. BW. Sound. Iowa State. #1-05587.

6. Television: How It Works. 16 mm. 11 min. BW. Sound. Coronet. #1-03584.

7. Typical Television Interference Patterns. 16 mm. 10 min. BW. Sound. UW. #1-05994.

A P P E N D I X

Quirmester Post-Test Samples

Quinmester Post-Test

Name _____ Date _____ Score ____

I. Completion Test Items - Fill in the blank or blanks with the word or words that make the statement correct:

ACCELERATING	DEFLECT	OVERCOUPLING	STAGGERED TUNING
ANODE	ELECTRONS	PROTONS	UNDERCOUPLING
BRIGHTNESS	FLUORESCENT SCREEN	SAWTOOTH	
CATHODE	FOCUS	SOURCE	
CONTROL GRID	IONS	SQUARE WAVE	

1. Every cathode ray tube must contain a _____ of electrons.

2. In order to visually indicate the presence of an electron beam a cathode-ray tube must have a _____ _____.

3. The anode in a CRT which controls the size of the light spot is called the _____ anode.

4. In order to rapidly move the light spot across the face of a CRT there must be some provision to _____ the beam.

5. By varying the number of electrons which strike the face of a CRT you get a visual variation in _____.

6. The two anodes which comprise a portion of the electron gun in a CRT are called the _____ anode and the _____ anode.

7. The element which is used to vary the intensity of the electron beam which strikes the face of a CRT is called the _____ _____.

8. The waveform applied to the horizontal and vertical deflection coils is in the form of a _____.

9. The two types of particles emitted by the cathode of a CRT are _____ and _____.

10. Two methods used to obtain wideband IF response in a TV receiver are _____ and _____ _____.

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Quinmester Post-Test

Name _____ Date _____ Score ____

II. True-False Test Items - Each of the following statements is either true or false. If the statement is true, draw a circle around the letter T following it; if the statement is false, draw a circle around the F. If a statement is false in part, it is entirely false.

1. Focusing in today's television receivers is obtained by means of electromagnets. T F

2. A sawtooth voltage waveform must be applied to the yoke in order to obtain horizontal and vertical deflection. T F

3. If ions are allowed to strike the phosphor coating of a CRT they will tend to knock particles of the phosphor loose. T F

4. In an intercarrier sound system the sound signal must be taken off after video detection occurs. T F

5. Direct coupling is one accepted method of obtaining wideband video IF response. T F

6. The output of a video detector must be positive when there is an odd number of video amplifying stages between the detector and the CRT grid. T F

7. Color TV uses the additive rather than the subtractive process to produce color. T F

8. Hue as used in color TV is used to define a wavelength in the visible light spectrum. T F

9. Saturation as used in color TV is a measurement of the presence of white light. T F

10. Brightness, as used in color TV, indicates light intensity. T F

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Name _____ Date _____ Score ____

III. Multiple Choice Test Items - Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the letter of the choice you make in the space provided at the right edge of the sheet.

1. What type of modulation is used to apply audio information to its carrier in TV (a) frequency modulation (b) amplitude modulation (c) phase modulation (d) single-sideband ( )

2. The frequency of the sound IF in TV is (a) 6 mc (b) 4.5 mc (c) 45.75 mc (d) 3.58 mc ( )

3. The maximum sound carrier deviation allowable in television is (a) 300 KH_z (b) 150 KH_z (c) 75 KH_z (d) 25 KH_z ( )

4. In an FM sound system, a change in the rate of deviation indicates a change in the (a) amplitude of modulation (b) modulating frequency (c) strength of the incoming signal (d) deviation ratio ( )

5. White light is made up of what percentage of the primary colors (a) 59% green, 11% blue, and 30% red (b) 1/3% green, 1/3% blue and 1/3% red (c) 59% green, 11% red, 30% blue (d) None of the above ( )

6. A combination of yellow and blue gives a (a) red color (b) white color (c) magenta color (d) green color ( )

7. The three characteristics of a color are (a) saturation, R-Y, and B-Y (b) brightness, hue, and saturation (c) hue, color and dominant wavelength (d) brightness, chroma, and tint ( )

8. The chrominance signal (a) conveys the brightness information (b) conveys the video information (c) conveys the color information (d) conveys saturation information only ( )

9. Where in the transmitted signal is the color reference burst placed (a) 3.58 mc away from sound carrier (b) back porch of horizontal blanking pedestal (c) front porch of horizontal blanking pedestal (d) none of the above ( )

10. The frequency of 3.579545 for the color subcarrier was picked because (a) much more color information is obtained (b) it was the only frequency left (c) it eliminates a beat frequency between the 3.58 mc and 4.5 mc (d) it places the color information between the black and white energy ( )

11. In order to be effective, the color burst signal must consist of at least (a) 2 cycles (b) 4 cycles (c) 6 cycles (d) 8 cycles ( )

12. The 3.58 mc reference burst is used to (a) carry color information (b) sync the horizontal oscillator (c) control phase and frequency of the 3.58 oscillator (d) gate the burst amplifier ( )

13. The five signals which make up the composite color signal are (a) R-Y, B-Y, G-Y, I, and Q (b) luminance, chrominance, burst, blanking, and sync (c) luminance, chrominance, burst, I, and Q (d) luminance, chrominance, sync, R-Y and B-Y ( )

14. A color difference signal is (a) the luminance signal minus the chrominance signal (b) the chrominance signal minus the luminance signal (c) I minus Q (d) a primary color signal minus the luminance signal ( )

15. The phase difference between the I and Q signals is (a) 33° (b) 90° (c) 180° (d) they are in phase ( )

16. What would be the (B-Y) signal value on a fully saturated red (a) 11% (b) 0% (c) -89% (d) -30% ( )

17. What would be the (B-Y) signal on a fully saturated yellow (a) 89% (b) 11% (c) -89% (d) -11% ( )

18. What would be the (R-Y) signal for a fully saturated yellow (a) 11% (b) 30% (c) 70% (d) 89% ( )

19. The R - Y, B - Y are called (a) composite signals (b) color difference signals (c) G - Y signals (d) I and Q signals ( )

20. The G-Y signal is developed at receiver by (a) a G-Y color demodulator (b) mixing B-Y and G-Y (c) combining certain percentages of R-Y and B-Y (d) using common control grids on the color differences amplifiers ( )

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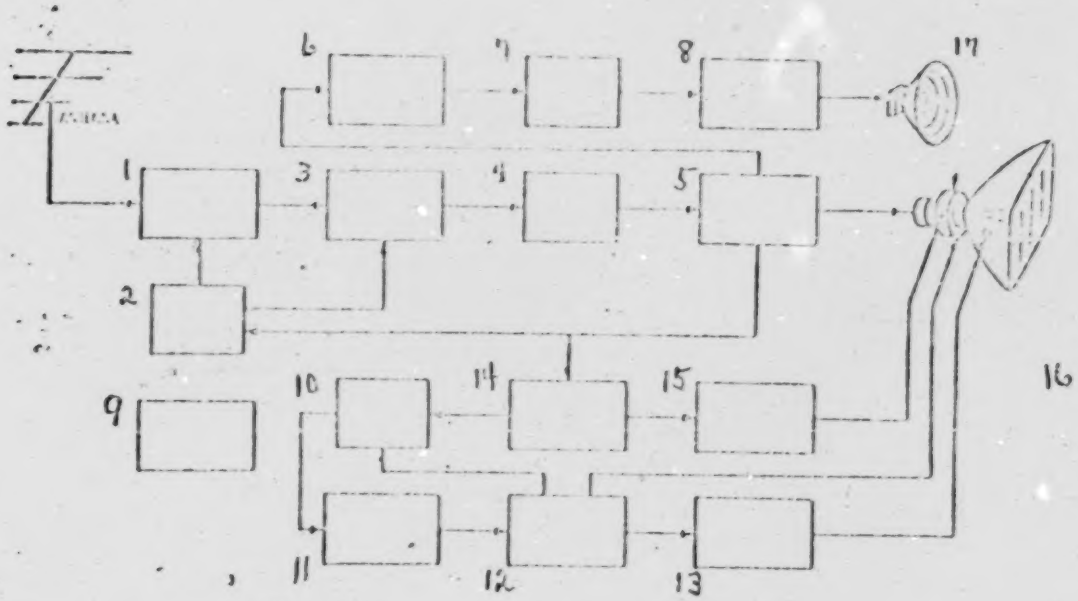
Quinmester Post-Test

Name _____ Date _____ Score ____

IV. Identification Test Items - Shown below is a block diagram of a black and white television receiver. Each block is numbered. Write the name of each block beside the number below the diagram which indicates that block.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____

POST-TEST KEY

I. Completion

1. Source
2. Fluorescent Screen
3. Focus
4. Deflect
5. Brightness
6. Focus-Accelerating
7. Control Grid
8. Sawtooth
9. Ion-Electrons
10. Overcoupling-Stagger Tuning

II.
1. F
2. F
3. T
4. T
5. F
6. F
7. T
8. T
9. F
10. T

III. Multiple Choice

1.	a	11.	d
2.	b	12.	c
3.	d	13.	b
4.	b	14.	d
5.	a	15.	b
6.	b	16.	d
7.	b	17.	c
8.	c	18.	a
9.	b	19.	b
10.	d	20.	c

IV. Identification Test Items

1. Tuner
2. AGC
3. Video IF
4. Video Detector
5. Video Amplifier
6. Audio IF
7. Audio Detector
8. Audio Amplifier
9. Power Supply (LV)
10. AFC
11. Horizontal Oscillator
12. Horizontal Output
13. Power Supply (H.V.)
14. Sync Separator
15. Vertical Deflection System
16. CRT
17. Speaker